B. Claims

Please amend claims 13-16 and 33-36 as follows. A complete listing of all the claims appears below; this listing replaces all earlier amendments and listings of the claims.

1. (Original) A method of producing a micro structure on a substrate, comprising the steps of:

forming on a substrate a first positive photosensitive material layer for photosensitizing by ionizing irradiation of a first wavelength band in a crosslinked state and forming a lower layer composed of a crosslinked positive photosensitive material layer by heat treating this positive photosensitive material layer;

forming on the lower layer an upper layer composed of a second positive photosensitive material for photosensitizing by ionizing radiation of a second wavelength band to thereby obtain a two-layered structure;

forming the upper layer with a desired pattern by irradiating the ionizing radiation of the second wavelength band to a predetermined portion of the upper layer of the two-layered structure and removing only the irradiated area of the upper layer by development treatment; and

forming the lower layer with a desired pattern by irradiating the ionizing radiation of the first wavelength band to a predetermined portion of the lower layer exposed by the pattern forming of the upper layer and conducting a development treatment,

wherein the first positive photosensitive material layer includes a ternary copolymer having a primary component composed of methyl methacrylate, and

methacrylic acid as a thermally crosslinkable factor and another factor for extending a sensitivity region relative to the ionizing radiation.

2. (Original) The method of claim 1, wherein the factor for extending the sensitivity region relative to the ionizing radiation is a methacrylate anhydride monomer unit.

3. (Original) The method of claim 1, wherein the crosslinkable process of the first positive photosensitive material layer is carried out by dehydration and condensation reaction.

4. (Original) The method of claim 2, wherein the ternary copolymer contains methacrylate of 2 to 30% by weight relative to the copolymer and is prepared by a cyclic radical polymerization at a temperature of 100 to 120°C using an azo compound or peroxide as a polymerization initiator.

5. (Original) The method of claim 1, wherein the weight average molecular weight of the ternary copolymer is ranging of 5,000 to 50,000.

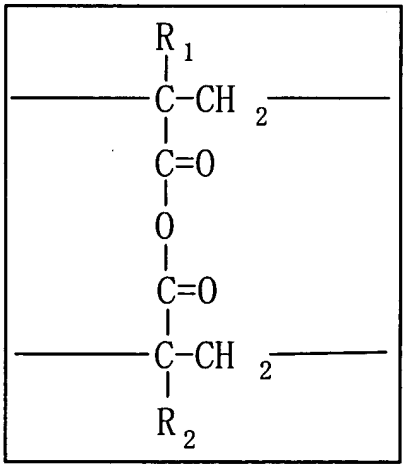
6. (Original) The method of claim 1, wherein the first positive photosensitive material contains at least a photo-degradable resin having a structure of carboxylate anhydride.

7. (Original) The method of claim 1, wherein the first positive photosensitive material is an acrylic resin that is intermolecular crosslinked through the structure of carboxylate anhydride.

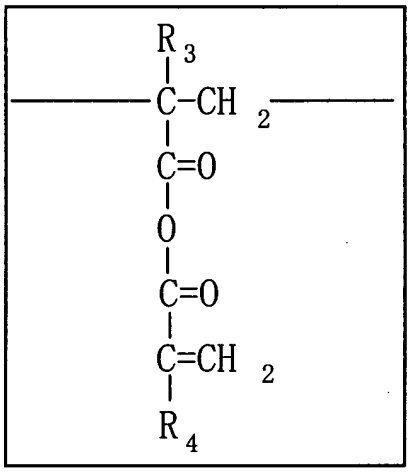
8. (Original) The method of claim 7, wherein the first positive photosensitive material is an acrylic resin having an unsaturated bond on a branched chain.

9. (Original) The method of claim 7, wherein the first positive photosensitive material has a structural unit represented by the following general formulas 1 and 2:

General formula 1



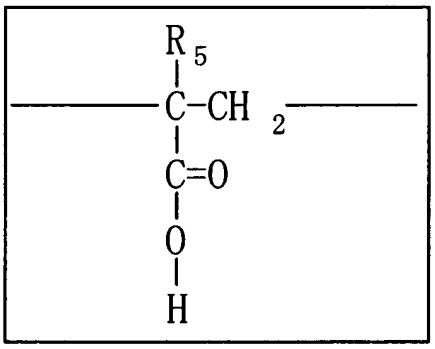
General formula 2



(wherein R_1 to R_4 denote a hydrogen atom or alkyl group having 1 to 3 carbon atoms and they may be the same or different from each other)

10. (Original) The method of claim 9, wherein the first positive photosensitive material has a structural unit represented by the following general formula 3:

General formula 3



(wherein R_5 denotes a hydrogen atom or alkyl group having 1 to 3 carbon atoms)

11. (Original) The method of claim 1, wherein the first wavelength band is shorter than the second wavelength band.

12. (Original) The method of claim 1, wherein the second positive photosensitive material is an ionizing radiation decomposable positive resist having polymethylisopropenyl ketone as a primary component.

13. (Currently Amended) A method of producing a liquid discharge head~~, which forms liquid flow path by~~ comprising the steps of:

(a) forming a pattern of removable resin on a liquid flow path forming portion on a substrate having a liquid discharge energy generation element, wherein said pattern is formed by

(1) forming on the substrate a first positive photosensitive material layer for photosensitizing by ionizing irradiation of a first wavelength band in a crosslinked state and forming a lower layer composed of a crosslinked positive photosensitive material layer by heat treating this positive photosensitive material layer;

(2) forming on the lower layer an upper layer composed of a second positive photosensitive material for photosensitizing by ionizing radiation of a second wavelength band to thereby obtain a two-layered structure;

(3) forming the upper layer with a desired pattern by irradiating the ionizing radiation of the second wavelength band to a predetermined portion of the upper layer of the two-layered structure and removing only the irradiated area of the upper layer by development treatment; and

(4) forming the lower layer with a desired pattern by irradiating the ionizing radiation of the first wavelength band to a predetermined portion of the lower layer exposed by the pattern forming of the upper layer and conducting a development treatment,

wherein the first positive photosensitive material layer includes a ternary copolymer having a primary component composed of methyl methacrylate, and methacrylic acid as a thermally crosslinkable factor and another factor for extending a sensitivity region relative to the ionizing radiation;

(b) applying and hardening a resin coating layer on the substrate to coat the pattern; and

(c) dissolving and removing the pattern~~, wherein the pattern is formed by the micro structure producing method of any one of claims 1 to 12~~.

14. (Currently Amended) The method of claim 13, wherein ~~the~~ a developing solution of the first positive photosensitive material includes at least:

(1) glycol ether having 6 or more carbon atoms miscible with water at any certain ratio;

(2) nitrogen-containing basic organic solvent; and

(3) a developing solution containing water.

15. (Currently Amended) The method of claim 14, wherein the glycol ether comprises ~~ethylenglycol~~ ethyleneglycol monobutyl ether, ~~and/or~~ diethyleneglycol

monobutyl ether, or a combination of ethyleneglycol monobutyl ether and diethyleneglycol monobutyl ether.

16. (Currently Amended) The method of claim 14, wherein the nitrogen-containing basic organic solvent comprises ~~preferably~~ ethanolamine, ~~and/or~~ morpholine, or a combination of ethanolamine and morpholine.

17. (Original) A liquid discharge head produced by the method of claim 13.

18. (Original) The liquid discharge head of claim 17, wherein a column-shaped member for capturing dust is formed on a liquid flow path as a material for forming the liquid flow path and this member does not reach to the substrate.

19. (Original) The liquid discharge head of claim 17, wherein a liquid supply opening commonly connected to each of the liquid flow paths is formed on the substrate and the height of the liquid flow path on the center portion of the liquid supply opening is lower than that of the liquid flow path on an opening circumferential portion of the liquid supply opening.

20. (Original) The liquid discharge head of claim 17, wherein a bubble generating chamber has a convex cross-sectional shape on the liquid discharge energy generating element.

21. (Original) A method of producing a micro structure, comprising the steps of:

forming on a substrate a first positive photosensitive material layer for photosensitizing by a light of a first wavelength band and forming a thermally crosslinkable film by the first positive photosensitive material layer by means of thermal crosslinkable reaction;

forming on the first positive photosensitive material layer a second positive photosensitive material layer for photosensitizing by a light of a second wavelength band different from the first wavelength band;

reacting only a desired area of the second photosensitive material layer by irradiating the light of the second wavelength band through a mask to the substrate surface formed with the first and second positive photosensitive material layers, forming a desired pattern by development then forming a desired slope on a side wall of the pattern by heating the substrate;

reacting a desired area of the first positive photosensitive material layer by irradiating the light of the first wavelength band through a mask to the substrate surface formed with the fist and second positive photosensitive material layers, and

which differentiates the upper and lower patterns with respect to the substrate using the process consisting of the above steps,

wherein the first positive photosensitive material layer includes a ternary copolymer having methyl methacrylate as a primary component, methyacrylic acid as a thermally crosslinkable factor, and another factor for extending a sensitivity region relative to the ionizing radiation.

22. (Original) The method of claim 21, wherein the factor for extending the sensitivity region relative to the ionizing radiation is a methacrylate anhydride monomer unit.

23. (Original) The method of claim 21, wherein the thermal crosslinkable process of the first positive photosensitive material layer is carried out by dehydration and condensation reaction.

24. (Original) The method of claim 22, wherein the ternary copolymer contains methacrylate of 2 to 30% by weight relative to the copolymer and is prepared by cyclic radical polymerization at a temperature of 100 to 120°C using an azo compound or peroxide as a polymerization initiator.

25. (Original) The method of claim 21, wherein the weight average molecular weight of the ternary copolymer is ranging of 5,000 to 50,000.

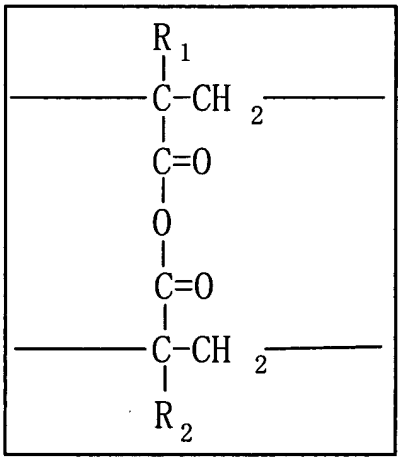
26. (Original) The method of claim 21, wherein the first positive photosensitive material contains at least a photo-degradable resin having a structure of carboxylate anhydride.

27. (Original) The method of claim 21, wherein the first positive photosensitive material is an acrylic resin that is intermolecular crosslinked through the structure of carboxylate anhydride.

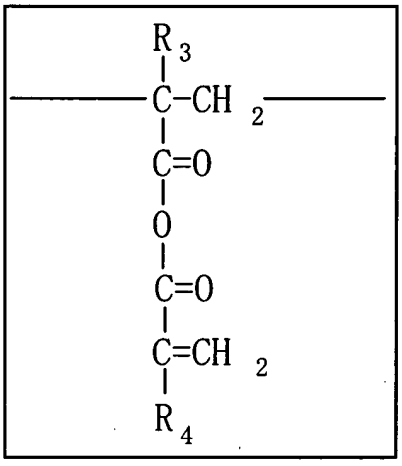
28. (Original) The method of claim 27, wherein the first positive photosensitive material is an acrylic resin having an unsaturated bond on a branched chain.

29. (Original) The method of claim 27, wherein the first positive photosensitive material has a structural unit represented by the following general formulas 1 and 2:

General formula 1



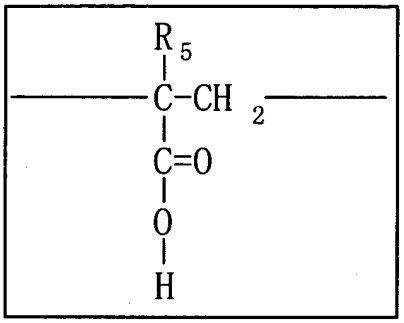
General formula 2



(wherein R_1 to R_4 denote a hydrogen atom or alkyl group having 1 to 3 carbon atoms and they may be the same or different from each other)

30. (Original) The method of claim 29, wherein the first positive photosensitive material has a structural unit represented by the following general formula 3:

General formula 3



(wherein R_5 denotes a hydrogen atom group or alkyl group having 1 to 3 carbon atoms)

31. (Original) The method of claim 21, wherein the first wavelength band is shorter than the second wavelength band.

32. (Original) The method of claim 21, wherein the second positive photosensitive material is an ionizing radiation decomposable positive resist having polymethylisopropenyl ketone as a primary component.

33. (Currently Amended) A method of producing a liquid discharge head~~, which forms liquid flow path by~~ comprising the steps of:

(a) forming a pattern of removable resin on a liquid flow path forming portion on a substrate having a liquid discharge energy generation element, wherein said pattern is formed by

(1) forming on the substrate a first positive photosensitive material layer for photosensitizing by a light of a first wavelength band and forming a thermally crosslinkable film by the first positive photosensitive material layer by means of thermal crosslinkable reaction;

(2) forming on the first positive photosensitive material layer a second positive photosensitive material layer for photosensitizing by a light of a second wavelength band different from the first wavelength band;

(3) reacting only a desired area of the second photosensitive material layer by irradiating the light of the second wavelength band through a mask to the substrate surface formed with the first and second positive photosensitive material layers, forming a desired pattern by development then forming a desired slope on a side wall of the pattern by heating the substrate; and

(4) reacting a desired area of the first positive photosensitive material layer by irradiating the light of the first wavelength band through a mask to the substrate surface formed with the first and second positive photosensitive material layers,

wherein the first positive photosensitive material layer includes a ternary copolymer having methyl methacrylate as a primary component, methyacrylic acid as a thermally crosslinkable factor, and another factor for extending a sensitivity region relative to the ionizing radiation;

(b) applying and hardening a resin coating layer on the substrate to coat the pattern; and

(c) dissolving and removing the pattern~~, wherein the pattern is formed by the micro-structure producing method of any one of claims 21 to 32~~.

34. (Currently Amended) The method of claim 33, wherein ~~the~~ a developing solution of the first positive photosensitive material includes at least:

(1) glycol ether having 6 or more carbon atoms miscible with water at any certain ratio;

(2) nitrogen-containing basic organic solvent; and

(3) a developing solution containing water.

35. (Currently Amended) The method of claim 34, wherein the glycol ether comprises ~~ethylenglycol~~ ethyleneglycol monobutyl ether, ~~and/or~~ diethyleneglycol monobutyl ether, or a combination of ethyleneglycol monobutyl ether and diethyleneglycol monobutyl ether.

36. (Currently Amended) The method of claim 34, wherein the nitrogen-containing basic organic solvent comprises ~~preferably~~ ethanolamine, ~~and/or~~ morpholine, or a combination of ethanolamine and morpholine.

37. (Original) A liquid discharge head produced by the method of claim 33.

38. (Original) The liquid discharge head of claim 37, wherein a column-shaped member for capturing dust is formed on a liquid flow path as a material for forming the liquid flow path and this member does not reach to the substrate.

39. (Original) The liquid discharge head of claim 37, wherein a liquid supply opening commonly connected to each of the liquid flow paths is formed on the substrate and the height of the liquid flow path on the center portion of the liquid supply opening is lower than that of the liquid flow path on an opening circumferential portion of the liquid supply opening.

40. (Original) The liquid discharge head of claim 33, wherein a bubble generating chamber has a convex cross-sectional shape on the liquid discharge energy generating element.